Improvements to the Optimal Cerebral Perfusion Pressure Calculation

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Background

Dynamic cerebral autoregulation (AR) assessments, such as the pressure reactivity index (PRx), can be used to determine a theoretically optimum cerebral perfusion pressure value (CPPOpt) to be targeted in brain injured patients. The standard CPPOpt algorithm fails to calculate a value in a significant amount of the time. We present an alternative algorithm, implemented in the CHART-ADAPT (www.chartadapt.org) project, and compare the absolute values and reliability to the standard algorithm.

Methods

Waveform resolution intracranial pressure and cerebral perfusion pressure values were recorded from 20 patients admitted to the neurological intensive care unit (NICU). The CPPOpt calculated using the standard method uses binning of PRx values over a CPP range and subsequent data reduction steps to enable the squared polynomial fit. Our alternative algorithm uses a simple generalised additive model (GAM) to find the CPP value associated with the minimum PRx value. Both algorithms were used to provide a CPPOpt value using a moving four hour window over the first 24 hours of NICU admission for each patient. We then compared the output of the algorithms by a linear mixed effects model. The model used per subject random effects to account for the paired nature of the data, as well as a compound symmetry correlation structure to cope with the repeated measures in time.

Results

The standard model was able to provide a CPPOpt value to target for 62.5% of the first 24 hours on NICU. Our alternative algorithm was able to provide a CPPOpt value for 100% of the time. There was a non-significant effect ($p = 0.74$) of algorithm on the calculated CPPOpt values.

Conclusions

Using our alternative algorithm we were more reliably able to calculate a CPPOpt to target in brain injured patients. These values were not statistically different from the values calculated using the standard method, indicating interchangeability of the methodologies. Further clinical studies are required to determine which of these methods is more suitable for future use to contribute to the management of brain injured patients.